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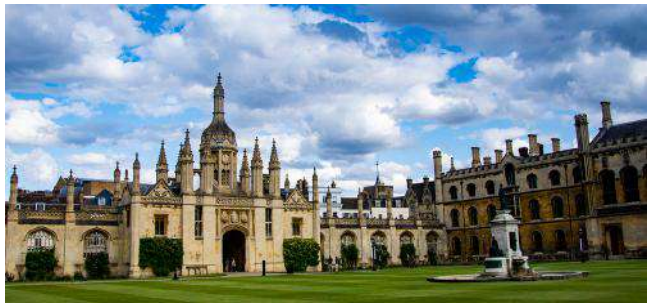


Engineering

SYLLABUS OVERVIEW
13-15 YEARS OLDS

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About Immerse

Immerse Education is an award-winning academic summer school provider offering programmes for 13-15 year olds in Cambridge University colleges.

The aim of these introductory programmes is to provide participants with academically challenging content in a classroom environment based on the university style of learning. Through 40 hours of academic sessions, the programmes also offer young students unique and valuable insights into what it would be like to study their chosen subject at an advanced level.

This Syllabus Overview provides a summary of the topics and subject areas that participants can encounter during their studies with Immerse. It has been carefully created by our expert tutors who are current members of world-leading universities, and who have experience in teaching undergraduate students.

Academic Sessions

The academic sessions at Immerse are arranged into modules to enable participants to explore a broad range of topics over the course of two weeks. The modules included in this syllabus overview are indicative but not prescriptive.

Tutors are encouraged to include their own specialisms and also focus on any particular areas of interest expressed by participants within the class. They may choose to provide further detail on a specific topic, or they may include new material and information that builds on the knowledge already developed during the programme.

Personal Project

Each programme includes an element of individual work, generally termed the 'Personal Project'. This can take many forms but is commonly an essay or presentation delivered on the final day of the programme. Participants will receive feedback on this work which may also be mentioned in the participant evaluation which is provided in writing by the tutor once the programmes have ended.

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Preparatory work

Some tutors may ask participants to complete some preparatory work, such as reading or a series of exercises in advance of the programme. Participants are strongly encouraged to complete this work since it will be included in the opening sessions of the programme. Any preparatory tasks will be provided in advance of the programme directly to the participant.

Academic Difficulty

As all of our programmes are designed to provide a unique introduction to advanced material, the syllabus will be academically challenging at times.

This is something to be excited about and all of our tutors will encourage and support participants throughout the programme. Immerse Education aims to develop every participant regardless of ability, and our tutors will adapt their teaching to individual needs.

Aim of the Engineering Programme

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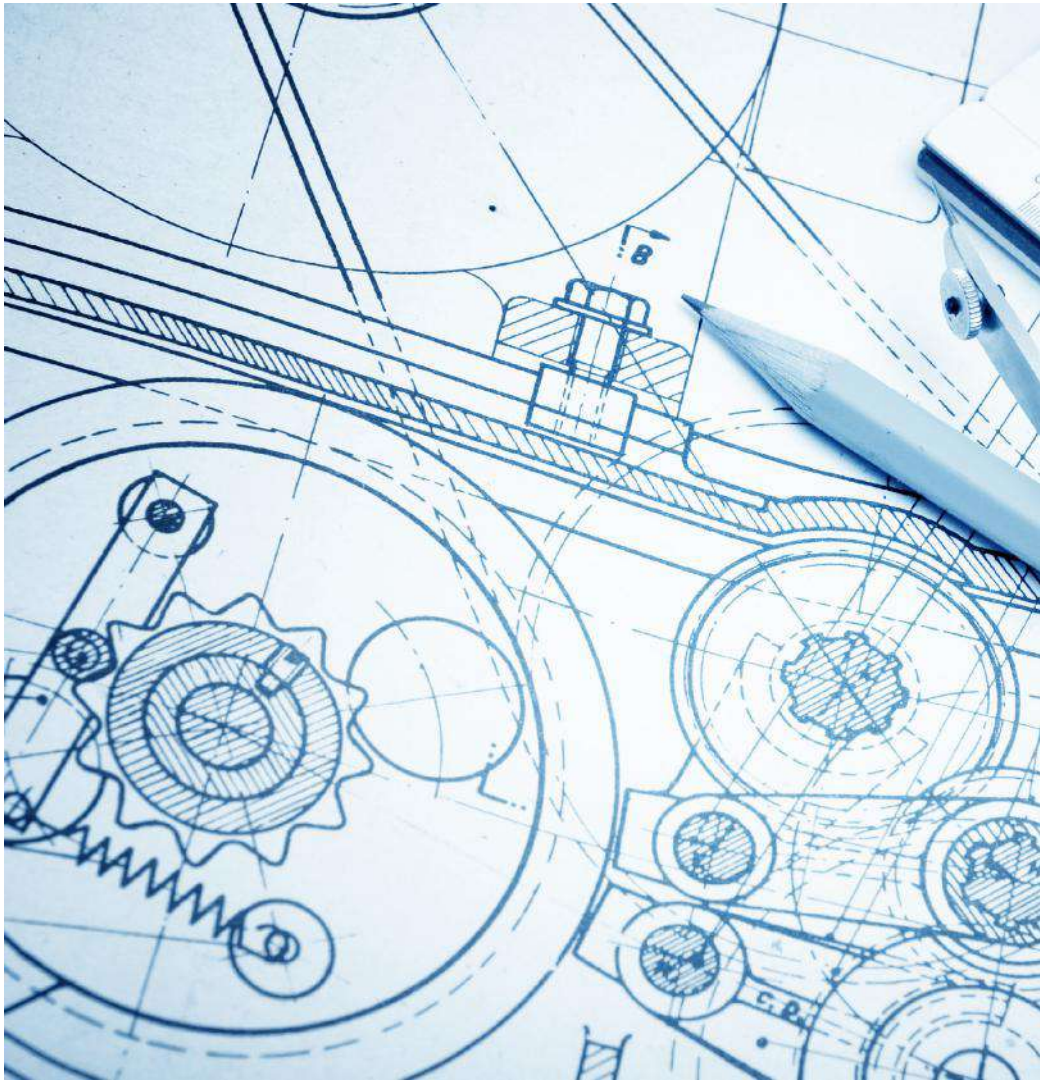
Engineering is a broad, interdisciplinary subject combining creativity with attention to detail, mathematical precision with novel means of expression. Knowledge of this field is also highly prized in industries all over the world and new opportunities are constantly emerging as technology continues to be driven forwards by the latest innovation. The aim of the Immerse Education Engineering programme is to introduce participants to the foundations of this subject and highlight the pathways that are available to those who would like to pursue engineering further in the future. Participants will get to grips with a variety of practical skills as they explore both the theory and practice of engineering.

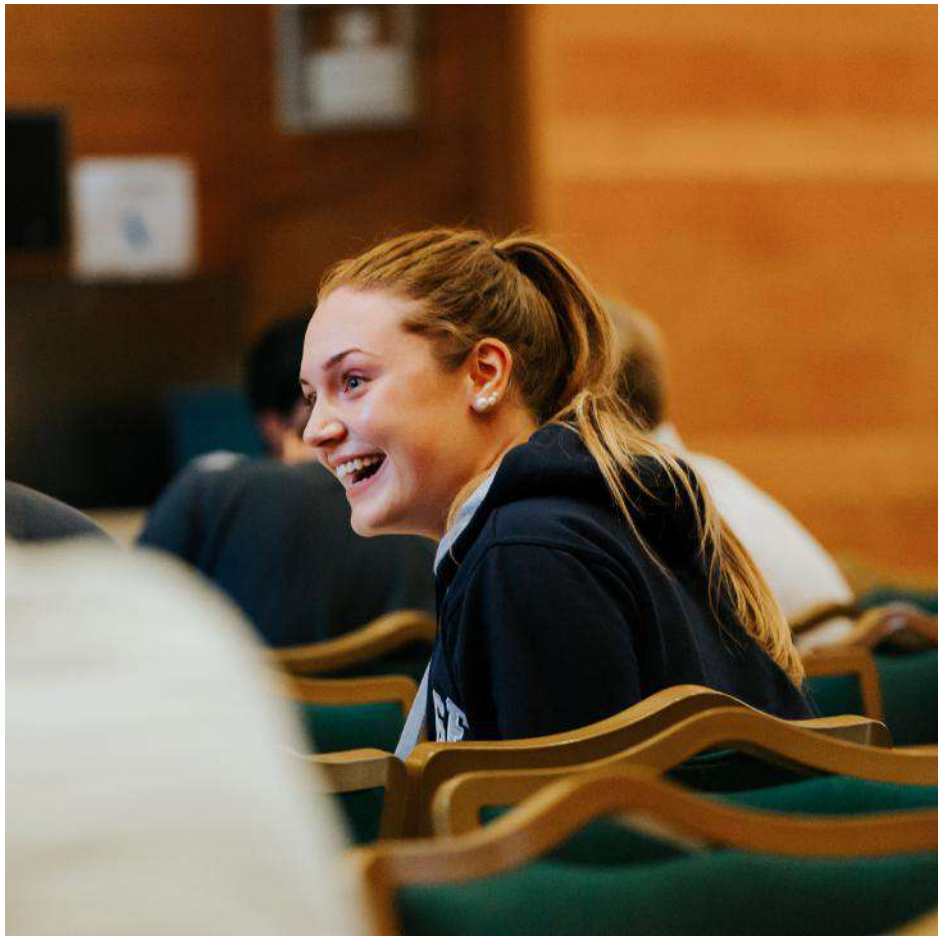
Introduction to Engineering

Participants will learn about the creative application of scientific principles to design and develop efficient, safe and economical processes, machines and structures with a view to better understand and modify the world around us. Participants will explore their preconceptions of what it means to be an engineer, the different fields within engineering and consider the achievements of leading engineers throughout history. Finally, participants will face a practical challenge that not only calls upon their skills as engineers, but also their ability to communicate effectively to relative strangers to achieve a common goal.

Introduction to Engineering Design

We will explore the engineering design process where numerous engineering case studies will be considered that best illustrate the design process and the challenges that come with it. Participants will consider key features such as conceptualization, feasibility assessment, preliminary design, detailed design, prototyping, feedback, and final production. Inspired by several case studies, participants will plan their own design process for their personal projects which looks to provide an engineered solution to a contemporary problem. Participants will produce a Gantt chart and begin the design process aiming for completion within the two-week period.





Industrial Revolutions

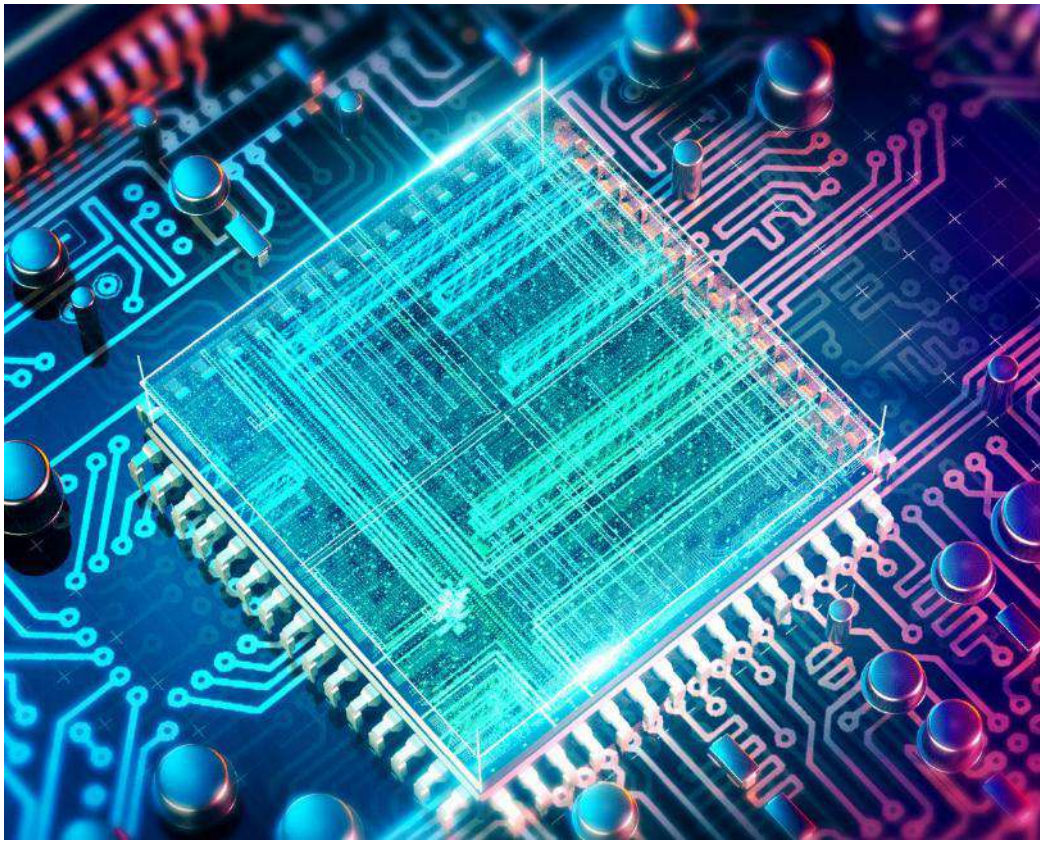
This session looks into the role of engineering in industrial revolutions. Engineering wonders from antiquity to the 19th century will then be contrasted with the rapid advancements in the 20th and 21st centuries. Key breakthroughs in each of the industrial revolutions will be identified. During this session, students will explore how mechanisation, mass production and automation have changed the face of the world. The session will conclude with a vision of how by combining the internet, 3D printing and renewable energy sources, the existing market structure of capitalism can potentially be challenged through a shift from consumerism to pro-sumerism which can give birth to a zero marginal cost society.

Introduction to Electrical Engineering

This session examines the birth of electricity. We will discuss the history of electricity and the discoveries and inventions that lead to what we now know as electricity. We will consider the laws of electromagnetism, the fundamentals of a motor and a generator, Ohm's law and the basics of electric circuit design. The use of AC and DC for the transport of electricity will be compared alongside the vision of Edison and Tesla. The underlying reasons for different voltage (110V vs 220V) in the US and the UK will be explored. In the afternoon session, the idea of renewable energy will be introduced.

Telecommunication Engineering

This session will build on our knowledge about the fundamentals of science where the history of communication and the developments within (from telegram to mobile phones) will be discussed. The students will be introduced to the electromagnetic spectrum and different carrier waves used for radio and cellular communication. They will also learn about the concept of modulation and demodulation and how amplitude modulation (AM) and frequency modulation (FM) work. The session will be complemented with practical challenges before participants consider how radio, Bluetooth and Wi-Fi communication function, all within the broader topic of telecommunication engineering.



Introduction to Electronics Engineering

This session considers the transistor – the invention that is at the heart of electronics engineering and without which the modern gadgets would not have the size and energy efficiency that they currently do. The session will build upon the knowledge of students about basic electronic circuits devices (resistors, capacitors, diodes, sensors, actuators etc.), where they will then be introduced to transistors. The use of transistor as a (i) switch and (ii) amplifier will be covered. The limits in light of Moore's law will be discussed, and quantum computing will be introduced as a revolutionary next step.

Introduction to Computer Engineering

This module looks into the design of digital systems (i.e., calculators and computers). The session will begin by introducing logic gates, their truth tables and how transistors can be used to make these logic gates. The design of an adder circuit will be discussed which adds two input numbers. Students will then be challenged to use this adder circuit to subtract two numbers and will be taught how computers subtract. Doing so, students will get a basic understanding of digital logic design and how computers and gadgets compute information.

Control and Automation Engineering

Participants will be introduced to signals and systems in particular the linear time invariant systems, time and frequency response, sampling, and aliasing. They will then be taught about classic PID (proportional-integral-derivative) control systems. With a technical understanding of how control and automation works, participants will then design a simple controller. With a growing fear of robots taking over jobs, and the notion of artificial intelligence, the students will take part in a 'moral machine' simulation game, where they will find themselves in a dilemma faced by driverless cars. The session will conclude with a debate on 'This house believes that artificial intelligence is a force for good'.

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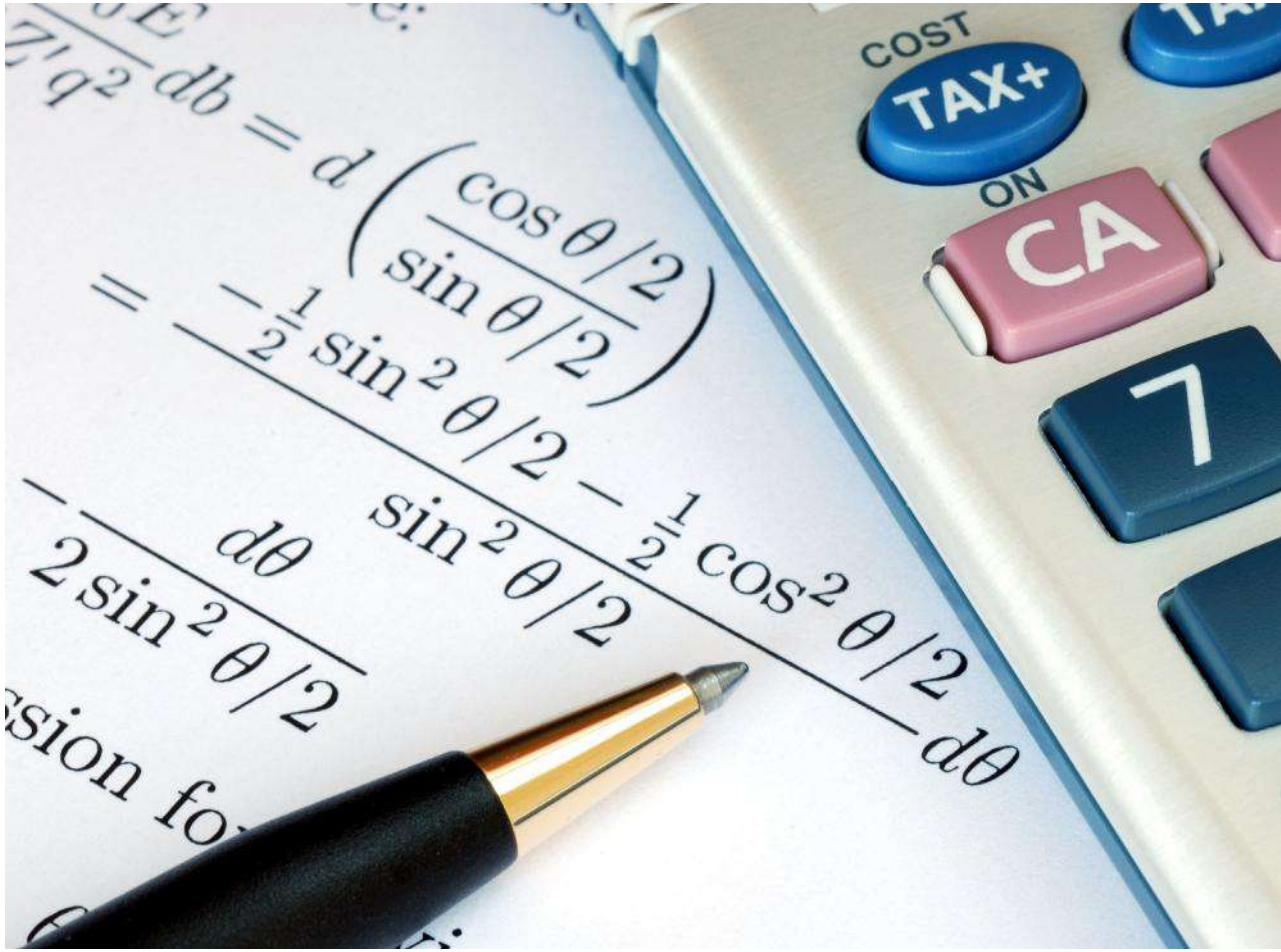
Engineering Mathematics

Mathematics is the language of science and engineering. Having identified the consequences of mathematical error, participants will explore the basics of multivariable calculus, linear algebra, and optimisation problems. Having covered a broad array of classical engineering fields, this module will feature a guest lecture that will talk about some of the recent engineering marvels. The guest speaker will introduce the students to virtual reality at the Institute for Manufacturing (IfM) followed by a discussion where students will be asked to suggest the potential applications of virtual reality. Commonalities in the design process will also be linked to another technological marvel (i.e., 3D printing).



Personal Project

Throughout the fortnight, participants will be working on their own personal project. Having been provided with a brief, participants should research and prepare a presentation together with a prototype for their peers. This will build upon aspects of the theory that they have learnt over the course of the programme and is also an opportunity to showcase the practical skills they have developed. The presentation is followed by questions from the audience and wider class discussion of particular points of interest. The tutor may also include feedback about the presentation in the written evaluation which is sent to participants after the programme has ended.

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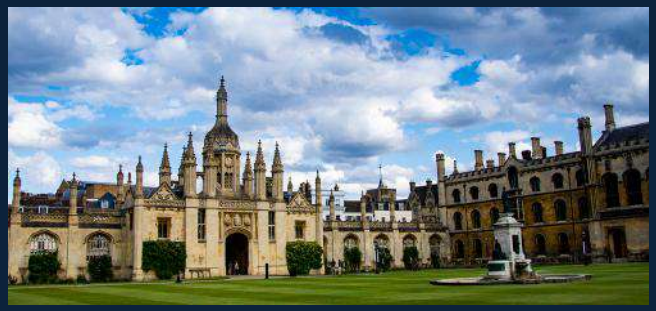


OUR AWARDS AND ACCREDITATIONS

THE QUEEN'S AWARDS FOR ENTERPRISE 2018

BAC ACCREDITED

COBIS SUPPORTING MEMBER | COUNCIL OF BRITISH INTERNATIONAL SCHOOLS

RoSPA Member

BETA British Educational Travel Association